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ABSTRACT

By making explicit the implicit assumptions about program costs and benefits, resource allocation in a nonprofit organization could be simplified. A rational scheme for implementing such a program might begin by using detailed interviews with program administrators to determine input and output scales. Following this, respondents could choose among feasible inputs for each of a series of budgets, and these inputs could then be compared with the output scales to measure each respondent's assumptions about the level of output possible from the level and type of input. Such information is useful in analyzing potential changes in resource allocations. (RA)

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IDENTIFYING EFFECT OF POTENTIAL BUDGETS ON PROGRAM OUTPUT

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IDENTIFYING EFFECT OF POTENTIAL BUDGETS ON PROGRAM OUTPUT

The difficulty in measuring costs and benefits, especially in nonprofit organizations, does not, of course, prevent analysis of resource allocation within this framework. In fact, such analyses are routinely made through implicit assumptions about costs and benefits and their relationships. This paper proposes a procedure for making these assumptions explicit.

In Part I the paper will describe a method for developing input and output (or performance) scales; for identifying the trade-off between inputs for several levels of activity through identifying points on the Engel curve; and for measuring the effect on program output of the points identified on the Engel curve. Part II will report on two applications of the technique.

PART I

COST BENEFIT ANALYSIS

As with any cost benefit analysis, the technique proposed identifies the effect on output of different input levels. It does so through identifying for a series of budgets preferred combinations of inputs allowed by each budget and comparing these preferences with output as represented by a scale. If one were relatively free to trade off among three inputs, then, for each of a series of budgets, he could indicate that input mix which he thinks would best accomplish the goals of the program--at least as he sees them. If one then had an output scale, each of these preferred input combinations could be compared with that scale to estimate what output could be achieved.

Ideally, this analysis should be done through identifying production indifference curves (transformation curves or isoquants);[1] consumption indifference curves; and the Engel curve[2] (consumption-income graph) as described by points of tangency of successive production and consumption indifference curves as resources inputs are increased. This would mean identifying the curves or functions in Chart I

which illustrates a series of indifference curves and four tangency points on the Engel curve A, B, C, and D. The X and Y axes represent two inputs into the program and the Engel curve indicates the preferred pattern of inputs. As illustrated in Chart II, the Engel curve is then related to output indicating the level of output to be expected from successive points on the Engel curve which, of course, reflects levels of input. This approach differs from the ideal cost-utility[3] analysis which seeks to relate input to output through a production function.[4] In the approach being set forth here the production function is implied by the trade-off of inputs as expressed through the Engel curve. Obviously this is a consumption approach to the analysis.

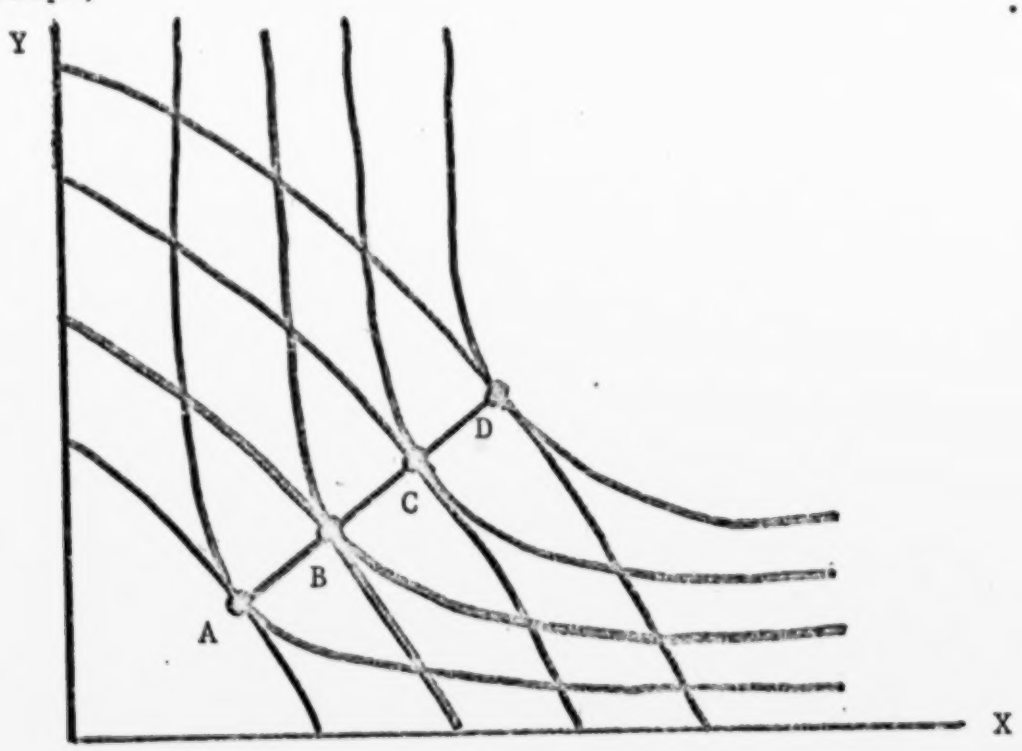
Identifying all of the functions illustrated in Chart I would be very difficult in most situations. An alternative to doing so is simply to identify a series of tangency points. This would give some information on the location of the Engel curve and allow a comparison with output. Assuming that the points of tangency are consistent with the technical limitations on the use of resources and with the indifference consumptions function, marginal productivity and marginal utility of the various allocations would be reflected.

DEVELOPING OUTPUT SCALE OR OBJECTIVES OF PROGRAM

While it is difficult to identify output of programs such as hospitals, libraries, and research and development, it can be approximated and in practice is done through crude surrogates. An underlying assumption of the output scale proposed here is that in virtually any process of evaluating resource allocation some empirical referents for output are used whether or not their usefulness is empirically or logically established. These referents could be identified through detailed interviews with appropriate people to provide the basis for a scale. The interview could secure information on how these individuals view the mission of the program and the referents they use in the identifying performance of the program. The emphasis in the interview would be to secure empirically identifiable

CHART I

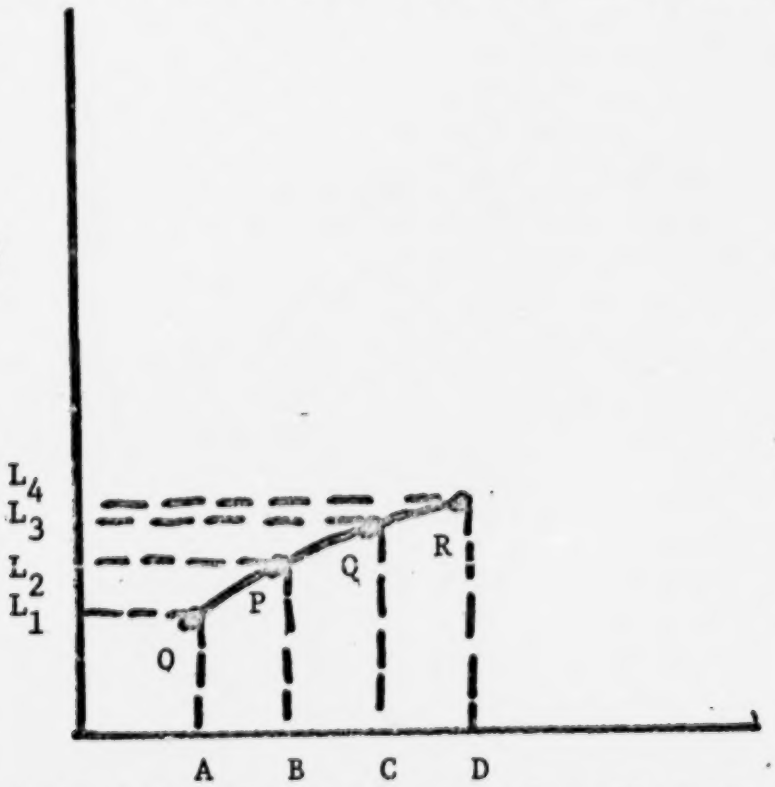
Expressed Trade-Off Between Two Program Inputs Giving Engel Curve. (Income-Consumption Graph)



(X, Y = inputs into the program; A, B, C, and D = points on Engel curve.)

CHART II

Assumed Relationship Between Program Input and Output. (Production Function)



(A, B, C, and D = Points on Engel curve from Chart I. O, P, Q, R = Points on Production Function)

phenomena, "proximate criteria,"[4] used by these individuals in considering their program's operation.[5]

Using this information it would then be possible to describe different levels of output moving from a low point to a high point of quality as viewed by the interviewee. Possibly the best way to do this would be to prepare a rather detailed description for several levels which will clearly be mutually exclusive. One could in this way construct a unidimensional, partially ordered scale. One might describe several aspects for each level making sure that each aspect described is clearly different from the same aspect on other levels. One would have the following arrangement:

Output Scale

	Aspect 1	Aspect 2	Aspect 3	Aspect 4	Aspect m
Level 1					
Level 2					
Level 3					
Level 4					
Level n					

In this table each cell in each column represents a detailed description which will be different and mutually exclusive from the items above and below (some aspects, of course, might not be applicable at all levels). This will insure that each level is clearly not overlapping with any other.

In preparing an output scale for a park's picnic facilities, one could use three aspects: condition of the facilities, quality of the facilities, and user satisfaction. For each level one can then write a description for each aspect. For the highest level the descriptions would indicate the very best situation where the facilities were of the best quality, kept in the best of care, and met all the needs of the users. As one moved down the scale, one would have three descriptions for each level of a situation which was less desirable than the one

above it, but all descriptions would be clearly not overlapping. If based on an interview, the descriptions should reflect as closely as possible the empirical referents of the respondent. One could proceed to develop a scale for other programs of the park or one for the park itself.

The validity of such an output scale would be no greater than the validity of the referents themselves. Such a scale, if nothing else, however, would at least make explicit the empirical evidence being used to identify output of the program. Assuming it has some reasonable validity reflecting the experience and understanding of the individual or individuals from whom the data were secured, one would have some empirical information to use in considering resource allocation.

IDENTIFYING POINTS ON THE ENGEL CURVE

To estimate points on the Engel curve one needs to prepare a scale for each input. This can be done as it was done for the output scale. One can prepare a set of descriptions for each input, proceeding to describe aspects for each input for as many levels as seems appropriate. In the case of an input such as personnel, for example, one might have described several levels of three aspects--experience, education and number. (In a matrix as illustrated in the previous section, one would title it "personnel" instead of "output."). While one would have only one matrix for output, he would have one for each input.

Next one would secure cost data to estimate the cost for each level of each input. Using this information one can then prepare a questionnaire based on a series of budgets which for the respondent would only be identified by a number or letter. The questionnaire would indicate the different combinations of inputs, in terms of levels, that would be possible for each budget. The questionnaire might appear something like the following for a particular budget. In this example, the respondent would be asked to select configuration 1, 2, 3, or 4, and thus decide which of his three inputs would be at level three and which at level

four. Similar options would be given for all other budgets. The number of configurations will typically increase as the budget increases.

Budget A

	Configuration 1	Configuration 2	Configuration 3	Configuration 4
Input 1	Level 4	Level 4	Level 4	Level 3
Input 2	Level 4	Level 4	Level 3	Level 4
Input 3	Level 4	Level 3	Level 4	Level 4

In going over the choices available with each budget, the respondent must consider the trade-off between the various resource inputs. The questionnaire itself presents for each budget several points on a production curve or isoquant and hence the respondent's choice will represent that point closest to a tangency point on his preference curve, a point on the Engel curve. Since each budget represents only selected points on the isoquant, the respondent's choice may not precisely represent a tangency point but the budget configuration closest to a tangency point. By increasing budget choices one can come closer to the true point on the Engel curve. A second questionnaire could be prepared once the general area of tangency has been located.

In many, if not most, situations it will be quite difficult to estimate with a high degree of accuracy the relationship of each budget to the various input levels. One would in effect be working with production indifference curves that would have to be thought of as wise curves with the width indicating the error in the estimate.

RELATING ENGEL CURVE TO OUTPUT

Identifying points on the Engel curve gives information on a person's preference pattern or trade-off among available inputs but does not indicate what output levels can be achieved. It would, therefore, be very helpful to know something of the relationship between the points on the Engel curve and the output scale.

Assuming that the respondent would like his choice behavior at least in resource allocation to be consistent with the axioms of utility theory[7] in that his choices will be consistent and transitive, then one can use the procedure described by von Neuman and Morgenstern[8] as well as by others in later works to measure the utility of each selected input configuration (estimated points on Engel curve) in terms of each point on the output scale. These input configurations are the ones selected by respondent through the procedure described in the immediately preceding section. Using such a lottery or gaming device will allow one to construct an index comparing the respondent's input making explicit the effect of each configuration on output that the respondent expects.

The procedure allows one to measure the respondent's expected utility for each input configuration in terms of performance as represented by the points on the scale with which it is being compared. The respondent is in effect being asked to weigh in his mind the output he thinks he can secure from a given input configuration with a given chance at a certain output. He must decide if the output he thinks he can secure from a given input configuration either exceeds or is less than (say) a 50% chance of achieving a specified output, and at some point be indifferent where he has a choice between 100% chance of receiving a given input and a 10% chance as point III on the scale. This would reflect a low utility for that input configuration compared with point III on the scale.

It is, of course, important to reemphasize that the cost estimates be sufficient accurate to give the respondent realistic choices. Furthermore, the input and output descriptions must be consistent with the respondent's concept of input and output and of program goals. This will reduce his uncertainty about the context within which he is to answer and will more accurately reflect his assumptions.

The respondent's indifference points could be displayed in the following manner with the entires in the cells indicating point of indifference.

Budget Configuration Preferences (Points on Engel curve)	Output Scale Where Each Point (Level) Equals Utility of One			
	I	II	III	IV
Budget A_4	.05	.25	.60	.90
Budget B_3	.15	.30	.80	.100
Budget C_5	.20	.35	.95	.100

Each percentage indicates the point at which the respondent is indifferent between that opportunity to achieve the level at the head of the column and a 100% chance to receive the budget for that row. Under the second column, for Budget B_3 the respondent is indifferent between a 30 percent chance at Level II and a 100 percent chance at the budget. Above 30 percent he would prefer the level but below 30 percent he would prefer the budget. The figures for each budget indicate what the respondent thinks of the potential of each budget in terms of each level. The higher the level the lower the value of each budget in terms of that level.

One could compare each budget choice only with level one on the output scale giving just the first column. By comparing, however, with each point on the output scale, one has additional information to analyze the output scale and to secure some insight into the respondent's assumption about the marginal returns as inputs are increased.

UTILIZING THE TECHNIQUE

The principal value of the technique is making explicit people's assumptions about the relationship of resource inputs and empirical indicants for a program including assumptions about incremental changes in resource

allocations. Through making the assumptions explicit the technique provides a basis for analyzing the program and for discussion by interested parties of resource allocation to the program. If the technique were used to secure the assumptions of several people concerning the program, this information could be used to clearly identify difference of opinion and provide a basis for developing a concensus concerning the effect of resources on the program. If the technique were used for several programs, it would provide assistance in comparing the relative effect on the programs of increases in resource allocation.

The technique can also be used to analyze the logic of the assumptions being made in resource uses. Inconsistencies could be exposed, for example, between trade-off expressed in the Engel curve and the output scale.

Even if the entire technique is not used, aspects of it can still be of use. The suggested scale for identifying output for example can be used simply to make explicit what the empirical referents are for identifying the output of a program which in turn will focus attention on being explicit about the purposes of the program. It will identify the referents used by the respondent in the preparation of budget recommendations and thereby provide a basis for reviewing their usefulness as proxies or surrogates for the objectives of the program. As long as the referents are not made explicit, such a review might not be easily made. One also has the basis for a review of the program objectives.

The output scale can provide an alternative to the use of a single factor in the evaluation of a program. So often an easily identified single factor is used because of its availability even though the rationale is weak. For example, the number of books in a library is typically used as a measure to give some indication of the usefulness of a library or the effect of resource

allocation to the library. In neither case is the number of volumes very useful because it leaves unsaid the quality of the books, the appropriateness of the books, and the quality of library service.

Another possible use of the output scale when used without the other elements of the technique discussed would be as an alternative to the typical statement of goals and objectives which are developed to guide the performance and evaluation of a program. These statements are usually not operational and where they are, they reflect only one level of operation or achievement. In providing several possible levels of achievement in empirically identifiable terms, an administrator is in a much better position to conceptualize the possible achievement of his program.

Where one can identify points on the Engel curve, he can estimate roughly the shape of the curve. This provides information on the trade-off between input and output for different levels of resources. The curve provides the basis for predicting what a person may do if resources available to him were changed. The curve, by making explicit his preferences in resource use, provides the basis for discussion with others concerning the use of resources in the program. If the curve were developed for each of several people, then the information could be used to reach a concensus on resource use.

APPLICATIONS OF THE TECHNIQUE

This technique can be used to make explicit the assumptions of people regarding the effect of resource allocation for a variety of types of programs where output is not clearly defined as a specific product or group of products. It could be used in the analysis of programs administered by municipal government to provide recreation, police, fire, garbage collection, or street

maintenance services. Rather than seeking some form of unit cost per product or service one could use this technique which could provide much better information. It would not be as satisfactory as a unit cost study that a manufacturer might compute but would be an improvement over vague assumptions and guesses that might otherwise be used. For example, developing the output scale for a parks program would make explicit the purpose of a park and the referents for identifying the degree to which the purpose is accomplished. The complete analysis would make explicit the assumptions of people involved in the administration of the park and help to identify differing assumptions that may exist among them. In making the assumptions of all these people explicit, it would focus attention on the analysis of these assumptions. Using this technique to analyze each of the city's programs would make possible comparing resource allocation among the various programs.

Similarly, the technique could be used at state and national levels for analyzing programs. It could be used in analyzing sections of a program as well as total programs. If the technique were used to analyze very large programs, it would, of course, become an expensive task. Developing input and output scales for a national program in parks and recreation and securing cost data would be a formidable undertaking. Yet extensive resources are allocated based on assumptions made by various officials concerning the effect of funds on programs and making these assumptions explicit by this technique would be a useful service. [redacted] The alternative would be to limit the analysis to subprograms. This technique could be used in connectio with program budgeting whereby it would be applied to each of the identified

programs of an agency for which separate budgets and economic analyses were needed.

In a business firm there are possibilities for using the technique where funds are expended for programs whose output is difficult to define. Some aspects of public relations programs suggest opportunities. Other opportunities might be found in programs for research and information gathering and for programs granting funds to educational and research agencies.

In a university the technique could be used to analyze the programs of academic departments. Identifying output referents for academic departments through a scale would alone provide very useful information.

LIMITATIONS OF THE TECHNIQUE

The obvious limitation of the technique is that the most it may do is make explicit people's assumptions. It does not in itself establish the validity of the output scale or of the relationship between input and output. It can, of course, provide a basis for doing this. The technique does not provide much information on the respondent's assumptions about the production and indifference curves other than as they are reflected in points to identify the Engel curve.

The value of the technique relies heavily on the ability to secure from a respondent information on his assumptions about the effect of resource use and/or the empirical criteria that he uses in evaluating program performance. Such information will be difficult to secure where the respondent has not given much thought to the empirical aspects of his program's performance or his assumption about relationship of resource input to resource output. Where he has he may still have difficulty expressing himself on these points.

The technique relies on the availability of people well acquainted with the program. Only people well acquainted with the program can be assumed to have formed useful ideas about output of the program and the effect of resource allocation. The technique also depends upon the respondent's behavior in adhering to the axioms of utility theory and the respondent's ability to respond to choices stated in terms of probability.

The technique can probably be used most easily with relatively small programs. As the program becomes larger, it may be more difficult to secure the necessary information and yet as programs become larger, it is more vital to make explicit people's assumptions about the program.

The technique, of course, suffers all of the limitations associated with securing information from people about their opinions through interviewing, such as the problems of securing cooperation, candidness, understanding interview questions, and all the others. The use of the technique requires a skillful investigator.

PART II

EMPIRICAL EXPERIENCE WITH THE TECHNIQUE: A HOSPITAL FOOD SERVICE

The technique was tried in two situations: the food service and the pharmacy of a small hospital.

DESCRIBING FOOD SERVICE INPUTS AND OUTPUTS

A detailed interview was conducted with the individual directly in charge of the food service who administers its budget and originates recommended changes in that budget. An open ended questionnaire was used to guide the interview which was conducted by two people, one carrying the burden of the interview and the other recording the responses.

There was no particular trouble securing detailed descriptions of the inputs which were readily and easily identified empirically. Securing a description of output was a little more difficult. As might be imagined the first description of output was in rather general and nonempirical terms. One of the key questions which helped to focus the respondent's attention on the empirical aspects of output or performance was to ask what specific items would be noted if asked to evaluate the performance of another hospital food service with a view toward making recommendations for change.

Estimating Points on the Engel Curve

Based on the interviews, the inputs were analyzed and grouped into four categories: supplies, personnel, space, and equipment. Four levels for each of these categories were described moving from a situation of rather meager resources to one with quite ample resources. For each category several aspects were described to reflect, for example, both quantity and quality. The descriptions were as empirically oriented as possible.

Once the descriptions were completed, they were submitted to the respondent to insure that they were consistent with his frame of reference for describing inputs into the food service program. The respondent reviewed the material, raised questions, and made a few suggestions. The descriptions were revised to reflect suggestions and eliminate misunderstandings.

Data were secured to determine the cost function for each of the four categories in order to estimate the cost of the inputs for each of the four levels described. There was no particular problem in securing the cost data with the exception of space which involved building depreciation. The objective in securing data was to insure that the questionnaire to identify preferences and the points on the Engel curve would be realistic for the respondent--so that the choices would be consistent with his experience and to be typical choices made in the administration of the food service as allowed by input costs.

Using this cost data, the questionnaire was prepared indicating the alternative input mixes possible for a set of budgets. The respondent was not told the amount of each budget. The budgets were identified only with a letter so that the respondent received a questionnaire with twenty-seven budgets identified by letter and an indication of the various combinations of inputs possible for each budget moving from a low to a high budget. The respondent was allowed to keep the description of the inputs while selecting his preference for each level. This gave twenty-seven estimated points on the Engel curve. It is assumed that the points did not fall on a smooth curve because of the lumpiness with which some of the resource inputs came (personnel, equipment, space).

Preparing the Output Scale

Again based on the interview a four point output scale was prepared with a detailed description prepared for each point with several aspects described. It is shown in Addendum A. Again, as with the description of inputs, the respondent was asked to review the output descriptions and to raise questions and make suggestions. The output description was then revised.

Identifying Relationship Between Inputs and Outputs

Using the technique described in Part I for measuring utility, the respondent was asked to make a choice between input configuration selected from those allowed by the smallest budget configuration chosen and the lowest of the four points on the output scale. The respondent was told that he had a fifty percent chance of achieving Level IV output or a 100% chance of receiving the particular input configuration involved. The odds were then varied to estimate the point of indifference, changing the odds in steps of ten. If the respondent preferred the budget even though the odds of receiving the given output level configuration reached a 100%, it was, of course, assumed that the respondent felt quite sure that with the given input configuration he could more than achieve the given level of output being compared.

Once a point of indifference was found, the interviewer went to the next budget and input choice. The interviewing procedure sought to place each budget choice somewhere between two points on the scale or below or above the end points. In the interviewing process if when asked the first question (comparing a 100% chance to receive a budget with a 50% chance to receive a given level) the respondent selected the budget, then the

chance to receive the level was increased in steps of ten until indifference was found. If he selected the level then the odds to receive the level were decreased by ten until indifference was found. The results of the interviewing are shown in Table I and Chart IV.

In the case of budgets A and B the respondent preferred the budget even though his chance to receive Level IV output was set at 100%. This meant that the output stated for Level IV was so low that the respondent felt that with budgets A and B he could achieve at least Level IV if not a little more than that. Since the respondent was indifferent between 100% chance at Level IV and a 100% chance at budget B it was assumed that the point of indifference for C would be above Level IV. As the chart shows, he preferred C until the chance to receive Level III dropped to .20. In the case of budget G he preferred the budget even where he had a 100% chance to receive Level III. G was then compared with II and the point of indifference was .10. This information would indicate that the respondent felt he could achieve Level III and possibly something beyond that. In some cases budget increments were so small or had so little effect on critical resource choices that respondent saw little difference. See, for example, choices for budgets P, Q, and R. He may, for example, have been more interested in increasing personnel which required a fairly large budget increase than increasing supplies made possible by small increments. Budgets V, W, and X took program above Level I. As the budgets are increased one has some insight into what the respondent thinks can be achieved with the budgets. The comparisons are rough but they do give an insight into the respondent's thinking and express his assumptions quantitatively.

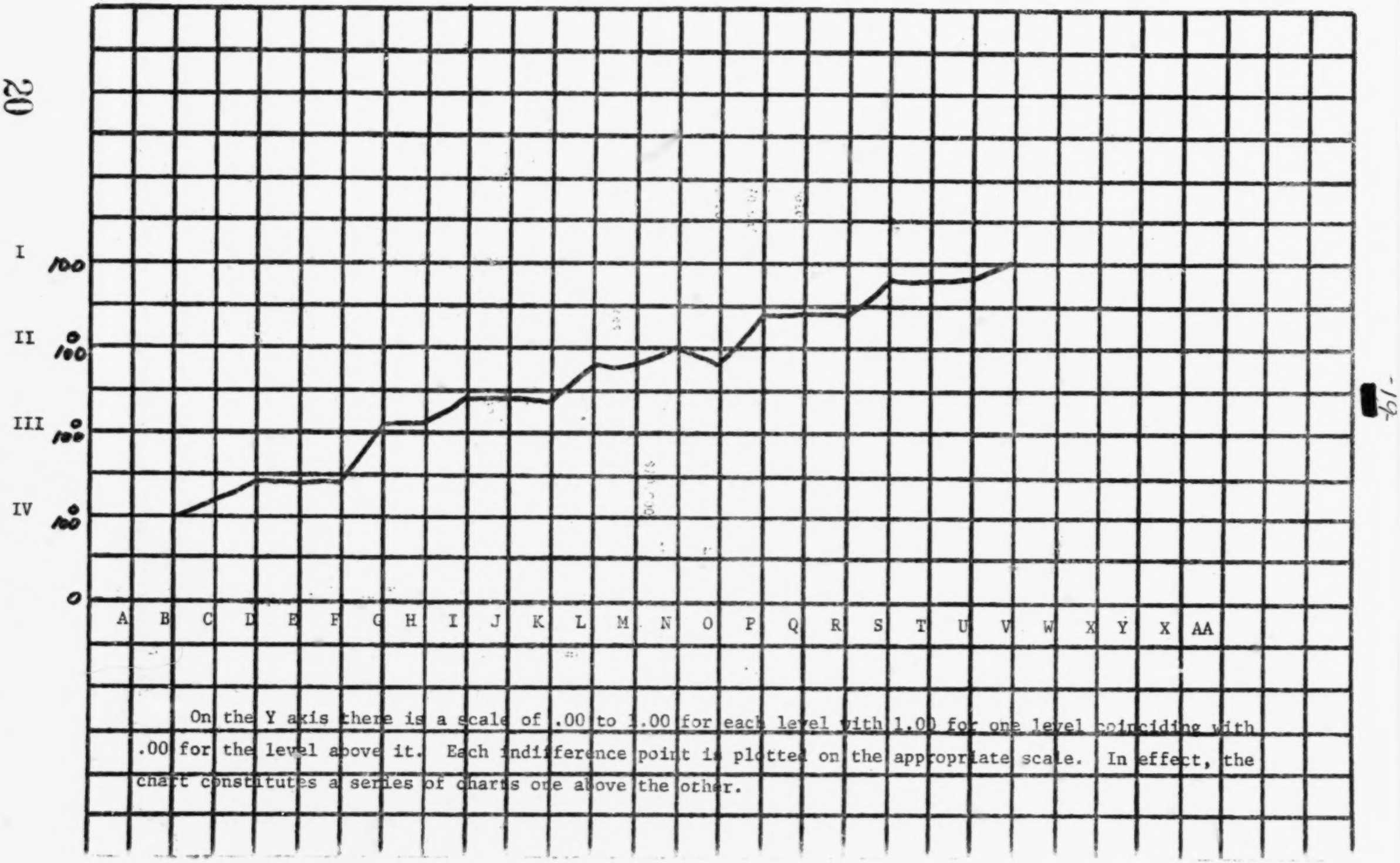
TABLE I

POINT OF INDIFFERENCE BETWEEN A SERIES OF BUDGETS AND OUTPUT LEVELS OF FOOD SERVICE

Budget	Point of Indifference Levels			
	I	II	III	IV
A				100
B				100
C			.20	100
D			.40	100
E			.40	100
F			.40	100
G		.10	100	100
H		.10	100	100
I		.40	100	100
J		.40	100	100
K		.40	100	100
L		.80	100	100
M		.30	100	100
N		100	100	100
O		.80	100	100
P	.40	100	100	100
Q	.40	100	100	100
R	.40	100	100	100
S	.80	100	100	100
T	.80	100	100	100
U	.80	100	100	100
V	100	100	100	100
W	100	100	100	100
X	100	100	100	100

CHART IV

INDIFFERENCE POINTS BETWEEN A SERIES OF BUDGETS
AND OUTPUT LEVELS OF FOOD SERVICE



On the Y axis there is a scale of .00 to 1.00 for each level with 1.00 for one level coinciding with .00 for the level above it. Each indifference point is plotted on the appropriate scale. In effect, the chart constitutes a series of charts one above the other.

In Chart IV the points on the X axis are equidistant since the X axis represents the budget and budget increments were equal. The distance between the four points on the Y axis, however, is not necessarily the same. The chart is drawn to assume this but that is not necessarily the case. The detailed descriptions assume they are mutually exclusive but that is all. The interviews with the respondent suggested that the distance between III and IV was considerably greater than between II and III and that the distance between II and III was somewhat greater than I and II, but not very much. The distance between the four points was not measured but the next test of the technique explored this problem.

EMPIRICAL EXPERIENCE WITH THE TECHNIQUE IN A HOSPITAL PHARMACY

The procedure followed with the pharmacy was essentially the same as that used in the food service with a few exceptions. The output scale (see Appendix B) had five instead of four points to make possible the use of a device described below to secure information on the distance between points on the scale. In input, "space " was not used because it was not a critical factor as in the food service and because of problems in securing meaningful cost estimates. The total number of budgets used in estimating points on the Engel scale was reduced since there was not the resource lumpiness found in the other operation. The interviews to secure data for the descriptions were taped because it became quite evident in the first interview that a complete transcript of the respondent comments was important if not critical in preparing the descriptions. The principal difference from the technique used in the food service was in the procedure to compare inputs with outputs. Instead of just one interview several were conducted to test alternative approaches to the one used in the food service study.

First Interview to Identify Relationship Between Inputs and Outputs

Using the technique described in Part I to measure utility, the respondent was asked to compare each budgetary choice with each output level. A set of cards was prepared which identified the budget and listed the configuration of inputs which the respondent had selected for that budget. The respondent was then told that he had to choose between a fifty percent chance to receive that budget or a 100% chance at level V. When a point of indifference was found or the respondent did not change from his first preference, he was then queried in a similar manner but asked to compare the given budget with level IV, then III and so on until his points of indifference was found between that budget and each of the five points on the output scale.

The results of the interview are shown in Table II.

TABLE II

Point of Indifference Where Utility of Each Level Based on Each Budget

	OUTPUT				
Budget	I	II	III	IV	V
A	0	0	0	0	0
B	0	.70	.25	.60	0
C	.80	.00	.35	.35	0
D	.70	.90	.40	.30	0
E	.80	.90	.40	.30	0
F	.80	.90	.45	.30	0
G	.70	.90	.30	.20	0
H	.70	.80	.30	.30	0
I	.80	.70	.20	.30	0
J	.70	.70	.30	.30	0
K	.80	.70	.40	.30	0
L	.90	.70	.20	.30	0

Since in the interview, the steps in the questioning when changing the odds were 10% at a time (50% chance, 40% chance, and so on) the point of indifference would be between the figure in the table and ten percent above. In the column under V, the points of indifference would be between 0 and 10%.

This table in effect compares each level of output with each budget, so that in reading from the right to the left one gets a measure of the utility of each point on the output scale in terms of the utility of the budget for the row being read. For example, level V clearly has a very low level of utility in terms of any budget. This is the reverse of what was done in the food service test.

This table was prepared to give some insight into the difference between the five points on the scale which it does. The distance between IV and V seems to be greater than between III and IV. The space between II and III seems greater than the previous two while the space between I and II seems not as great as any of the rest. One could develop measures of the distance using this data.

Second Interview to Identify Relationships Between Input and Output

In the second interview the process was reversed from the first. The respondent was asked to compare each budget choice with each level but was told that he had a 50% chance at the level and a 100% chance at the budget. This technique gave the information that was secured from the respondent in the case of the food service plus a great deal more.

The results of this interview are given in Table III (those not in parenthesis). In this case the table can be interpreted as giving

the utility of each budget in terms of level of output. As one reads down column one he, in effect, reads the utility of each budget in terms of Level I of output. Where there is a 100% this means that that level or one higher could be achieved with the given budget.

As one will note, there are some odd figures in Table III. In column I, budget A, for example, is given a rating of 80 which seems odd. Because of such items, the respondent was asked to go over the table and insert in parenthesis his estimate of what he thought he could do with each budget in terms of each level of output. Some inconsistencies remained. For example, with budget D and E it would appear that if the budgets would allow a 50 and 30 percent chance respectively of achieving level II, they should allow at least that with level III rather than zero as shown.

The table indicates that the respondent feels that with any budget he can at least achieve level IV. There is some differentiation between what he can do in achieving levels I, II, and III but not a great deal.

It was felt that the redundancy of information in Table 3 would help to overcome problems of communication with respondent as well as his ability to analyze decisions within the context of the standard gamble in measuring utility. It is felt that the table does do this in giving a reasonable estimate of what can be accomplished. Some of the apparent inconsistence is due to the estimate of the Engel choices and some situations created by different budgets when compared with each other. This was true in both interviews and because of the problem the additional estimates are helpful.

TABLE III

LEVEL OF OUTPUT POSSIBLE WITH A-L BUDGET INPUTS

BUDGET	I I	II II	III III	IV IV	V V
A	[0]80	[0]70	[0]70	*[100]100	[100]100
B	[0]70	*[5]70	[0]60	[100]100	[100]100
C	[10]80	[75]90	*[90]100	[100]100	[100]100
D	[0]70	*[50]60	[0]100	[100]100	[100]100
E	[0]80	*[30]80	[0]80	[100]100	[100]100
F	[0]70	*[30]80	[0]70	[100]100	[100]100
G	*[80]80	[100]90	[100]100	[100]100	[100]100
H	*[85]80	[100]90	[100]100	[100]100	[100]100
I	*[70]70	[90]80	[100]100	[100]100	[100]100
J	*[90]90	[100]90	[100]100	[100]100	[100]100
K	*[95]90	[100]70	[100]100	[100]100	[100]100
L	*[100]90	[100]90	[100]90	[100]100	[100]100

The use of the pharmacy was probably not a very good choice because the degree of flexibility in what can be done is not great and certainly not as great as was apparent in the food service. In retrospect, it would have been wiser to do the pharmacy study first and the food service study second.

It is important to note, however, that in both interviews the respondents proved most interested in the study. In the case of the pharmacy the respondent asked to keep copies of the descriptions of input and output feeling that this would be helpful in making budgetary requests. He felt they provided descriptions that would be useful in budget requests. He also commented that when making choices he realized that these were certainly the kind of choices he was always making.

The figures in Table III with asterisks correspond to figures that would have been secured using the technique used in the Food Service study.

Third Interview to Identify Relationships

The final interview was designed to secure directly, information on the relative distance between the five points on the output scale. The technique is described in detail in an article by Sidney Siegel, "A Method for Obtaining an Ordered Metric Scale."[9] Briefly, the respondent was given a series of cards on which he had to make a choice between two pairs of the five points on the scale expressed in a two-by-two matrix. He was told that after he had selected one of the two pairs a single item in the pair would be selected with each having the same probability. Each card had the following format:

	A	B
50	I	II
50	IV	III

The respondent was asked to pick either A or B and was told that the upper or lower row would then be selected for him with each row having a probability of .5 of being selected. For example, in this illustration, if he selected A then he knew either I or IV would be selected with a probability of .5.

In making up the cards all possible combinations of the five points were prepared following the rule that the two items in the

[redacted]

[redacted]

cells on the right would always fall between the two items on the left. A total of 13 cards were prepared.

The results were interpreted in the following manner. In the illustration above, for example, if the respondent chose A, it was assumed that IV and III were closer than I and II. Put somewhat differently, the option of A was preferred to B because the gain in I over II was greater than the loss of IV compared with III. This can be readily seen if instead of I, II, III, and IV, we had in the four cells $100, $15, $10, and $9 in the same order.

On the other hand, if the choice were B, it would be assumed that the distance between IV and III were greater than I and II. This can be seen if instead of I, II, III, and IV, we had in the four cells $100, $15, $10, and -$500. The prospect of paying $500 might be sufficiently bad to cause the respondent to choose B with the choices of $15 and $10.

Using this technique and following closely the procedure suggested by Siegel, it was discovered that the respondent's choices were perfectly transitive and consistent in all 13 cards. This then gave an ordered metric measure for the five points as shown below where the distance[5] were as follows:

IV to V greater than III to IV
III to IV greater than II to III
II to III greater than I to II

Graphically this is given below:

I II III IV V

Combining this information with that received in interview number two would suggest that the marginal return following the achievement of

level III started decreasing rapidly. After achieving Level III with budget C, increases in the budget needed to achieve Level I which possibly could have been done with a budget less than A, did not have as great a payoff as did the smaller budgets. This information certainly is consistent with the concept of diminishing returns. In this case, they begin to set in sooner than [redacted] in the case of the food service which again is reasonable since there is greater flexibility in the use of resources there than in the operation of a small pharmacy.

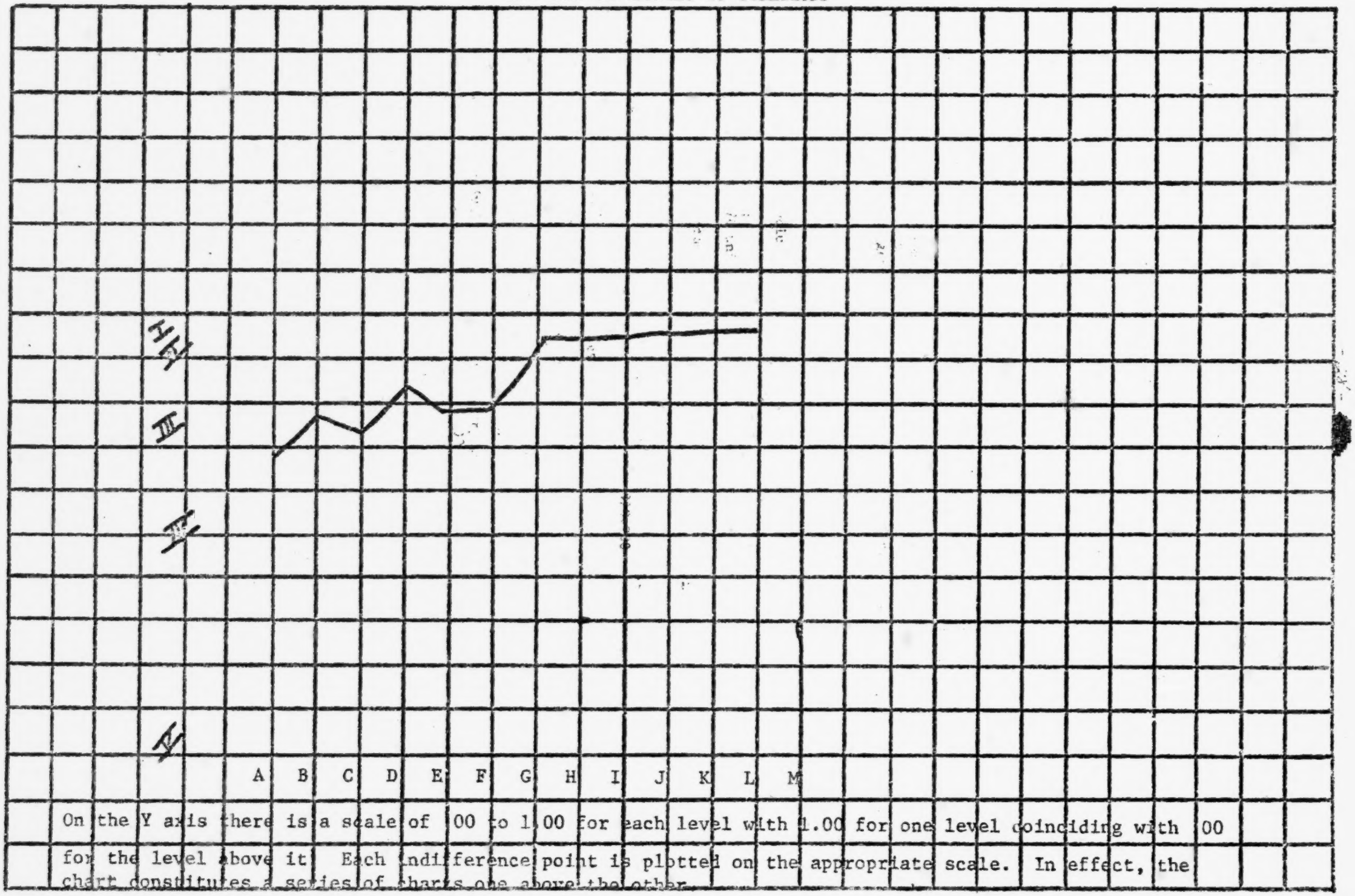
Chart V has been drawn to correspond with Chart IV. The five points on the Y axis have been placed to reflect the respondent's ranking of distance between the five points. The items in Table III with asterisk are the ones plotted.

CONCLUSION

In neither of the two cases was there a problem in securing reasonable descriptions. In the interviewing situations there was some confusion caused by using the word "level" in discussing inputs and outputs. Sometimes the respondent would think that level I input would give level I output. It would have been better to use some term other than "level" for either input or output. One could have simply referred to output as A, B, C, D, and E. It might also have been better to reverse the order so that increasing amounts of input were reflected by going from IV to I while increased levels of output might have been reflected by going from A to E.

CHART V

INDIFFERENCE POINTS BETWEEN A SERIES OF BUDGETS
AND OUTPUT LEVELS OF PHARMACY



On the Y axis there is a scale of 00 to 1.00 for each level with 1.00 for one level coinciding with 00 for the level above it. Each indifference point is plotted on the appropriate scale. In effect, the chart constitutes a series of charts one above the other.

While these two examples did not take into consideration significant fluctuations in demand on the systems, the descriptions could be prepared to reflect this where demand can vary greatly. The highest level could indicate the availability of resources to allow the system to perform at the top level at peak demand. Another variable not included in the two tests was the possibility of comparing different technologies or systems but these two variables could also be incorporated in the technique.

An interesting problem arose during the interviewing for the food service. To secure some additional experience working with the technique the administrator directly over the person interviewed was also interviewed. This respondent was given the same questionnaire to select the preferred input configuration for each budget and he completed the questionnaire indicating his choice. A limited interview was also conducted in which he was asked to express his choice between a 100% chance at receiving a given budget configuration, or a 50% chance at achieving a given level. This was the same technique used in interviewing the individual directly in charge of the food service. The question raised by the respondent in the interview was: "If I select the choice giving me a 50% chance at Level I, what happens if I don't achieve level? Does a 50% change at level I mean I could get something a little less than I or much less than I."

To one not acquainted with the use of probabilities in a gaming situation to find points of indifference, an alternative might be used where the individual is given a two-by-two matrix as was done with the administrator of the pharmacy in comparing the relative

values of the five levels of output. Some have expressed that this is a better approach to measuring utility. (This is the approach suggested by Frank Ramsey. Fellner discusses the issue briefly in his book Probability and Profit.[10]) In this situation the use of the technique would be to place in the two cells on the left output levels and on the right input budget configurations. This was not done in this study because the results achieved were considered satisfactory in testing the basic approach to making explicit assumptions about the relationship between resource inputs. Using such cards might, however, secure more satisfactory information.

It should be repeated for emphasis that the technique seeks to make explicit a person's assumptions about the relationship between input and output. It does not validate the relationships expressed. In using the technique it is also necessary to remember that a person's aversion to risks is an important factor and should be measured as an aid in analyzing the results of measures suggested here. An interesting procedure would be to use this technique to make explicit the opinion of several people involved in a program and then use this material as a basis of a conference to develop a group consensus on the relationship. Since group consensuses are used to allocate resources, these techniques could help make the thinking of members of the group more explicit. Another interesting possibility would be for a study to begin by developing the output scale based not on an interview with those responsible for a program but rather those who are its consumers. The interview would seek to identify those empirical criteria used by the consumers of a program's output to evaluate

the program. One could then interview those responsible for the program to relate Engel curve points to the output scale based on consumers. There would of course be a serious problem in using this technique if those responsible for the program were unable to relate the points on the Engel curve to the consumers output scale because it was so different from one based on their referents' for output.

A final point to stress is the need to develop detailed and empirical descriptions of inputs and especially outputs and within the framework of the respondent. This provides a sound basis for analyzing cost data and assumptions. In these two tests the major portion of the total time was devoted to this task.

FOOTNOTES

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[2]William J. Baumol, Economic Theory and Operations Analysis (2nd ed.; New Jersey: Prentice-Hall, Inc., 1961), pp. 192-193.

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[4]Hitch and McKean, op. cite.,pp. 105-133.

[5]Roland N. McKean, Efficiency in Government Through Systems Analysis, (New York: John Wiley & Sons, Inc., 1958), pp. 28-29.

[6]Russell L. Ackoff, Scientific Method: Optimizing Applied Research Decisions, (New York: John Wiley & Sons, Inc., 1962), p. 71.

[7]John von Neuman and Oskar Morgenstern, Theory of Games and Economic Behavior, (Science Edition, New York: John Wiley & Sons, 1964, originally published by Princeton University Press, 1944), chapter 3.

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Herman Chernoff and Lincoln E. Moses, Elementary Decision Theory, (New York: John Wiley & Sons, 1959), pp. 79-86.

[8]von Neuman and Morgenstern, op. cite., pp. 16-24.

Baumol, op. cite., ch. 22, pp. 512-528.

Howard Raiffa, Decision Analysis: Introductory Lectures on Choices Under Uncertainty, (Reading, Massachusetts: Addison-Wesley, 1968), ch. 4 pp. 51-100.

[9]Sidney Siegel, "A Method for Obtaining an Order Metric Scale," Psychometrika, volume 21, number 2, June 1956.

[10] Donald Davidson, Patrick Suppes, in co-operation with Sidney Siegel, Decision Making: An Experimental Approach, (Stanford: University Press, 1957).

William Fellner, Probability and Profit, (Homewood, Illinois, Richard D. Irwin, Inc., 1965).

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APPENDIX A

Program: Hospital Food Service

Output (Performance)

Level I

Aspect I, MENU:

The patient can select from a generous variety of meat, vegetables, salads, desserts, breads, and beverages.

The menu includes high-quality tender cuts of meat (some cooked to order), gourmet delicacies such as game, lobster tail and shrimp Newburg; and desserts contain generous portions of expensive ingredients such as butter, eggs, and flavorings (for example, French ice cream).

Preparation is excellent, the food is very delicious, and the portions are generous.

Aspect 2, PERSONAL ATTENTION:

Meals are served within specified hours; but during that time the patient rings when he wants his meal, someone comes to him to take his order, and the main course is served promptly.

When the patient finishes his main course, he rings, and someone comes to remove dishes and take his order for dessert. Dessert is served immediately.

When the patient finishes dessert, he rings again, and the remainder of the meal is removed promptly.

Someone checks frequently to see that food and service are satisfactory.

Aspect 3, SERVICE DETAILS:

The food is served at proper temperature almost without exception.

The tray is attractively arranged with good quality ceramic dishes, good quality flatware and glassware, and cloth napkins.

APPENDIX A

Program: Hospital Food Service

Output (Performance)

Level II

Aspect 1, MENU:

The patient can select from a more restricted list of meats, vegetables, and desserts than in Level I service.

The menu includes no gourmet delicacies or dishes requiring individual preparation, but food is of good quality. It includes less expensive types of meat (as some of the "tough" cuts) and desserts (for example, good quality American ice cream.)

Preparation is good, the food is appetizing, and portions are adequate for most tastes.

Aspect 2, PERSONAL ATTENTION:

Meals are served to all patients at one time, and service is prompt. The patients indicate their selections on a card at the previous meal.

Dessert is served 15 minutes after the main course, at which time the main course dishes are removed.

Trays are collected from all patients at one time.

Someone checks occasionally to see that food and service are satisfactory.

Aspect 3, SERVICE DETAILS:

The food is served at proper temperature 90% of the time.

The tray is neat, and individual ceramic dishes are used. Napkins are of good quality paper.

APPENDIX A

Program: Hospital Food Service

Output (Performance)

Level III

Aspect 1, MENU:

The institution uses many menus, but the patient has no choice at any one meal.

Food is average in quality and includes a high proportion of "budget" foods such as hamburger dishes, chili, and popularly priced ice cream.

Preparation is average, the food is palatable, and portions are adequate.

Aspect 2, PERSONAL ATTENTION:

Meals are served to all persons at one time, and service is prompt.

Dessert is served on the tray with other courses.

Trays are collected from all patients at one time.

Very seldom is any check made to see that food and service are satisfactory.

Aspect 3, SERVICE DETAILS:

The food is served at proper temperature 2/3 of the time.

Food is served in individual dishes.

Little attempt is made to arrange the tray, but paper napkins are supplied. Appointments tend to "look cheap."

APPENDIX A

Program: Hospital Food Service

Output (Performance)

Level IV

Aspect 1, MENU:

The same menu is offered every 7 days, and the patient has no choice at any one meal.

Food is inferior in quality and preparation, and is unappetizing. Meat portions contain large proportions of fat and gristle, potatoes are often blackened and waterlogged or soggy with grease; vegetables are "old" or overcooked; the rice pudding is gluey or baked to a crisp; the pie crust is tough, thick and indigestible.

Aspect 2, PERSONAL ATTENTION:

Meal times vary as much as an hour.

The entire meal is served at once.

Trays are seldom collected less than 1-1/2 hours later.

Aspect 3, SERVICE DETAILS:

The food is rarely served at proper temperature.

Food is served in metal compartment trays and is sloppily arranged.

No napkins are supplied.

APPENDIX B

OUTPUT: Drug Service

ASPECT: Formulary

LEVEL I: The Health Service Physician has the option to prescribe the exact medication he wishes the patient to have, (i.e. virtually all types and concentrations of medications are stocked.)

Medications and therapeutic equipment are dispensed free of charge to students and other university personnel.

Students are able to obtain common medicinals such as: aspirin, salt tablets, vitamin pills, anti-bacterial soap, etc., free of charge from the pharmacy upon request. (No prescription is necessary.)

LEVEL II: The student may receive precise medication for those diseases previously anticipated by the Therapeutics Committee of Health Service.

The major portion of medication is dispensed free of charge to students. The patient must, however, pay cost price for the very expensive drugs.

Students are able to obtain common medicinals such as: aspirin, salt tablets, etc., upon request. They must, however, pay cost price of the item.

LEVEL III: The student is able to obtain medication for 'chronic' diseases from the Health Service Pharmacy. Medication for other diseases and infections must be obtained elsewhere.

Students must pay cost price for all medication received from the pharmacy.

They can only receive medicinals via prescription and must pay retail price for these.

LEVEL IV: There is a very limited supply of drugs which the student may obtain from the Health Service Pharmacy.

Students must pay retail price of those received.

No medicinals are available for students.

LEVEL V: No pharmacy per se.

No drugs or medicinals are dispensed from Health Service Pharmacy. A few aspirin, cold tablets are available in the physicians' offices.

APPENDIX B

OUTPUT: Drug Service

ASPECT: Service Details

LEVEL I: Students receive the exact medication prescribed upon arriving at Health Service Pharmacy in convenient "pop top" plastic containers. Doses are individually packed inside the container.

Medication is dispensed to all areas (hospital, out-patients, emergency clinic, etc.) at all hours of the day and night - seven days a week.

The attitude of the Pharmacy personnel is very friendly and professional. Verbal instructions are given in addition to the typed label. Where antibiotics are prescribed the patient is given the first dose on the spot.

Drugs are delivered to the student's residence twice daily.

LEVEL II: Students receive the prescribed medication from Health Service Pharmacy in convenient rigid containers with minimum delay.

Medication is dispensed 12 hours a day - six days a week. The needs for other areas such as emergency room and hospital during the closed hours are accurately predicted and stocked each evening.

The Pharmacy personnel are quite amiable. Instructions are typed clearly on the package.

Deliveries are made to the student's residence each day around supper time.

LEVEL III: Students receive the prescribed medication from H.S. Pharmacy in flimsy paper containers. Students must wait in line to receive their prescription. The length of delay is a function of the number of students requiring medication at this particular time, (usually about 10-20 minutes delay.)

Students may have their prescriptions filled eight hours a day, five and one-half days a week. Other areas such as Hospital and Emergency Room must anticipate their needs daily and request these from the Pharmacy each morning.

APPENDIX B

(continued)

OUTPUT: Drug Service

ASPECT: Service Details

LEVEL IV: Medication is dispensed each morning from 9 a.m. to 12 p.m., Monday through Friday. As a result, long lines usually develop and both patient and pharmacist become quite irritated.

No medication other than aspirin, etc., is available to other areas of health service during closed hours.

LEVEL V: Health Service does not maintain a Pharmacy per se which dispenses drugs. What drugs are available are stored in the physicians' offices and given to the student where possible.

APPENDIX B

OUTPUT: Drug Service

ASPECT: Information Service

LEVEL I: Virtually any type and amount of information concerning drugs and their manufacturer's is available (to physicians or the university community) immediately upon request of the Health Service Pharmacy. The information given is continually being updated and includes information on both medical drugs and other chemicals of interest such as L.S.D., etc.

LEVEL II: The information available from Health Service Pharmacy covers a broad but non-intensive area of drugs and their manufacturers.

LEVEL III: The information available from Health Service Pharmacy is limited to the general knowledge of drugs obtained by Pharmacists during their university training as students of Pharmacology.

LEVEL IV: Very little information concerning drugs is available to the university community. No information concerning drug manufacturers is available.

LEVEL V: No information is available.

APPENDIX B

OUTPUT: Physical Atmosphere

ASPECT: Pharmacy Appearance

LEVEL I: The Health Service Pharmacy is housed in a well lit, fully enclosed area. Sound-proof glass and wood panels separate the dispensary area from the library and reference area as well as the research area, etc. The design of the department layout and the specific activity areas provide for optimal efficiency of effectiveness. All of the pharmacy's business activities (cash budgets, receipts, etc.) are centrally administered by the Health Service Business Manager.

LEVEL II: The Health Service Pharmacy is located in fully enclosed area. This area provides adequate space to enable certain activities to be separated in terms of their location. (There are no physical partitions separating the activities.) Pharmacists must handle all business activities such as balancing cash receipts with register slips, etc.

LEVEL III: The Health Service Pharmacy is located in a small room. Adequate space exists for the present limited line of drugs only. All activities (dispensary, reference material, compounding, cash register, etc.) are located within the same area. This causes some distraction. Aisles are tight and there is little room for expansion.

LEVEL IV: Because of limited available space, the Health Service Pharmacy must share its quarters with two other departments (student medical record department and emergency treatment room.) The area is cramped and much confusion and distraction results.

LEVEL V: No pharmacy per se - the small amount of drugs available are stored in the physicians' offices.

APPENDIX B

OUTPUT: Physical Atmosphere

ASPECT: Professionalism

LEVEL I: Drugs in open stock are neatly arranged and classified in the most effective manner. New shelf arrangements are introduced at varying intervals to assure proper checking and control with regard to filling prescriptions. Dispensing procedures employed by the Pharmacists are the best available and provide for minimum dispensing time with maximum effectiveness and control. The inventory control system is very effective. Stockouts are never experienced.*

LEVEL II: Drugs in open stock are well arranged and classified adequately. New shelf arrangements are introduced only after a mistake in filling out a prescription is made and has been detected. Dispensing and inventory control procedures are for the most part adequate. Stockouts occur, but very infrequently.

LEVEL III: The arrangement of open stock drugs provides minimum effectiveness. The Inventory and Dispensing Procedures employed do not provide the speed and control necessary for effective and efficient operations. Students are frequently required to wait 10 to 15 minutes for their prescriptions to be serviced.

LEVEL IV: Because of the cramped quarters the open stock drug arrangement is confusing. A rudimentary inventory system exists. Stockouts occur frequently.

LEVEL V: No pharmacy per se - dispensing procedures are subject to the desires of the individual physicians.

*Stockouts: running out of stock for a particular drug.